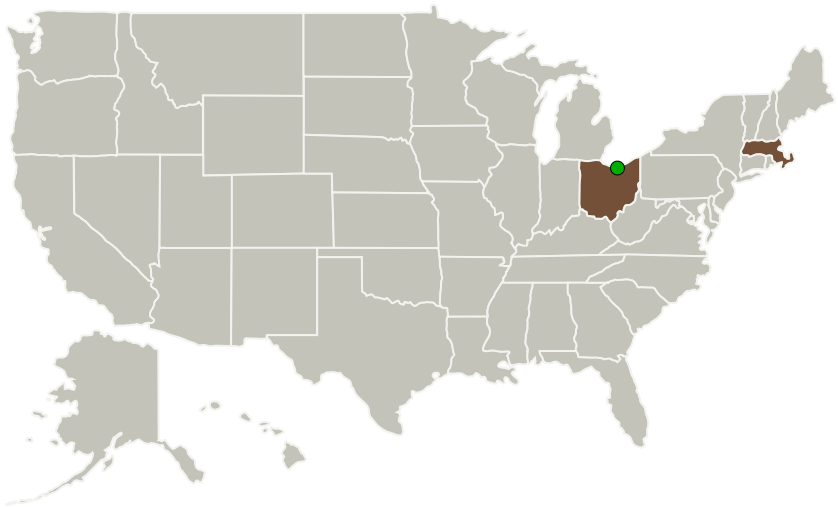
High Temperature Resistant Zirconia Coating for In-space Propulsion, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

To enhance NASA systems, Spire proposes a novel technique for growing a graded nanocrystalline ZrON/ZrO2 protective coating with superior heat tolerance on relevant in-space substrates. The proposed coating technology will adhere to and protect engine components such as injectors, combustion chambers, nozzles, and nozzle extenders. Conventional high temperature coatings applied by chemical vapor deposition inadequately adhere, and often spall. The proposed coating will distribute stress induced by thermal cycling and improve adhesion, resulting in an improved and longer lasting coating. The high temperature phase of ZrO2 is produced by controlling nucleation, grain growth, and grain size via the unique features of our deposition technique. The increased surface energy of the nanograins results in the formation of a dense cubic phase of zirconia, which is stable at very high temperature. Phase I will develop a base-line process for applying highly adherent, thermally-resistant cubic ZrO2 layers on in-space propulsion substrates with a functionally graded ZrON metalloceramic transition layer at the metal interface. The deposition guidelines for nanocrystalline ZrON/ZrO2 coating will be perfected to each unique substrate in Phase II. In addition, a number of metallic components will be coated and delivered to NASA to be evaluated for in-space propulsion use.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Spire Corporation	Lead Organization	Industry	Bedford, Massachusetts
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Massachusetts	Ohio

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138225)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Spire Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

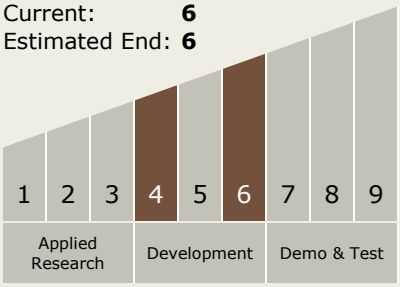
Carlos Torrez

Principal Investigator:

Nadar Kalkboran

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System